

ITCS285 – Final Exam Revision

Select the appropriate answer for each of the questions below.

1. Which of the following relational algebra operations do not require the participating tables to be union-compatible?
 - a. Union
 - b. Intersection
 - c. Difference
 - d. Join
2. What is a disjoint less constraint?
 - a. It requires that an entity belongs to no more than one level entity set.
 - b. The same entity may belong to more than one level.
 - c. The database must contain an unmatched foreign key value.
 - d. An entity can be joined with another entity in the same level entity set.
3. A relation R is in (1) _____ if it is in (2) _____ and every non-key attribute of R is fully functionally dependent on every key of R .
 - a. (1) 2NF, (2) 1NF
 - b. (1) 3NF, (2) 2NF
 - c. (1) BCNF, (2) 2NF
 - d. (1) BCNF, (2) 3NF
4. Comparing any value with (1) _____ yields (2) _____.
 - a. (1) 1,000,000,000, (2) TRUE
 - b. (1) NULL, (2) UNKNOWN
 - c. (1) NULL, (2) FALSE
 - d. (1) UNKNOWN, (2) TRUE
5. No attribute of a (1) _____ can ever be NULL in any tuple. But attributes declared (2) _____ may have NULL values.
 - a. (1) PRIMARY KEY, (2) NOT NULL
 - b. (1) JOIN, (2) UNIQUE
 - c. (1) PRIMARY KEY, (2) UNIQUE
 - d. (1) relation, (2) PRIMARY KEY

Consider relation $R(ABCDE)$ with functional dependencies:

$A \rightarrow C$
 $A, C \rightarrow B$
 $B, C \rightarrow A$
 $D \rightarrow C$
 $D \rightarrow E$

6. Which of the following sets of attributes is a key of R ?
 - a. $\{A, D\}$
 - b. $\{D\}$
 - c. $\{B\}$
 - d. $\{A, E\}$
7. Which of the following sets of attributes is not a superkey of R ?
 - a. $\{A, B, C, D, E\}$
 - b. $\{A, B, C\}$
 - c. $\{D, A\}$
 - d. $\{B, C, D\}$

Consider the relation **R1**(A,B,C,D,E,F) with the following functional dependencies (FDs):

A,B → C (1)

C → B (2)

C → D (3)

B,C → F (4)

D → E (5)

1. Find all candidate keys of R1. **(2 Pts)**

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2. Is R1 in 2NF? Justify your answer. **(1 Pt)**

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3. Is R1 in 3NF? Justify your answer. **(1 Pt)**

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4. Is R1 in BCNF? Justify your answer. **(1 Pt)**

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Now, suppose a relational schema **R2**(A, B, C, D, E, F, G, H, I, J) and a set of functional dependencies:

$$A, B \rightarrow C \quad (1)$$
$$A, D \rightarrow G, H \quad (2)$$
$$B, D \rightarrow E, F \quad (3)$$
$$A \rightarrow I \quad (4)$$
$$H \rightarrow J \quad (5)$$

1. Identify all candidate keys for R2. **(2 Pts)**

[illegible]

2. Check out that R2 is in 3NF or not? If not decompose it in 3NF. **(3 Pts)**

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Consider the following relational database instance that represents the relations *books*, *publishers*, and *Published* (books published by publishers).

Table 1. Books

ISBN	Title	Author	Date	Edition
231	The Soul of a New Machine	Tracy Kidder	1981	1
77	Programming Pearls	Jon Bentley	2000	2
23	Programming Pearls	Jon Bentley	1981	1
2	Tess of the d'Urbervilles	Thomas Hardy	1850	1

Table 2. Publishers

PID	Publisher	City	Web Site
1	Back Bay Books	Boston	backbay.com
2	Addison Wesley	New York	addisonwesley.com
3	Modern Library	London	randomhouse.com
4	Penguin	New York	penguin.com

Table 3. Published

ISBN	PID	Pages	Copyright
1	231	293	1981
2	77	235	2001
2	23	200	1980
3	2	565	2001
4	2	540	1990

- The date in the *books* table represents the year when the book was originally issued.
- The Copyright in the *Published* table represents the copyright date when that publisher issued it.
- ISBN numbers are unique book identifiers.
- PID are unique publisher identifiers.

1. Does this database schema allow for a book to have more than one publisher? Explain why or why not using an example. **(2 marks)**
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2. Does this database schema allow for a book to be not currently being published? Explain why or why not using an example. **(2 marks)**
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3. List two super keys of the relation *books*. **(2 marks)**
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4. List all candidate keys of the relation *books*. **(2 marks)**
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5. Do all the attributes in a relation represent a superkey for that relation? **(2 marks)**
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6. List all candidate keys of the relation *Published*. **(2 marks)**
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7. List all superkeys of the relation *Published*. **(2 marks)**
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8. What two meanings best describe a *null* web site value in the publishers table? **(2 marks)**
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9. List all foreign keys in the database. Be explicit by naming the referencing and referenced relations and the appropriate attributes. **(2 marks)**
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10. Indicate whether inserting the tuple (4,83,200,1990) into the table *Published* is valid or not and why? **(2 marks)**
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4. Modify the model (**by adding to Figure 1, not by drawing another figure**) so that you can represent the following: **(5 marks)**

- Each patient has to have one and only one primary physician. Each physician has at least one patient. We want to know at least the specialty and the date of entry into the profession of each physician.
- Instead of modeling only the fact that a patient takes certain drugs, model the fact that a patient takes certain drugs that are prescribed by a physician and the prescription date.
- Pharmaceutical companies have long-term contracts with pharmacies. A pharmaceutical company can contract with several pharmacies, and a pharmacy can contract with several pharmaceutical companies. For each contract we want to store a start date, an end date.
- Pharmaceutical companies could be private, public, or semi-public. For private companies, we need to store the acceptance license date.

Consider two relations R(A, B, C, D) and S(A, B, C, D), with the following functional dependencies:

R:
 $A \rightarrow B, C, D$
 $B \rightarrow A, C, D$
S:
 $B, C \rightarrow A, D$
 $D \rightarrow B$

1. Find all keys in R. (1 mark)

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2. Find all keys in S. (1 mark)

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Consider a relation R1 (A,B,C,D, E) with the following dependencies:

$A \rightarrow B,$
 $B, C \rightarrow E,$
 $E, D \rightarrow A$

1. List all candidate keys for R1. (1 mark)

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2. Is R1 in BCNF? (1 mark)

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Given relation R2(A, B, C, D, E, F, G) and the set of functional dependencies

$B, C, D \rightarrow A$

$B, C \rightarrow E$

$A \rightarrow F$

$F \rightarrow G$

$C \rightarrow D$

$A \rightarrow G$

1. Show that (B,C) could be a key of R2. (1 mark)

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2. Is R2 in 2NF? Justify your answer. If not decompose to 2 NF. (2 marks)

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3. Is R2 in 3NF? Justify your answer. If not decompose to 3NF. (2 marks)

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4. Check whether your decomposition satisfies BCNF normal form. (1 mark)

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Let's consider the three tables: Vehicle, Customer, and Rent.

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CREATE TABLE Customer (  
  C_id INT PRIMARY KEY,  
  name VARCHAR(255),  
  age INT,  
  role VARCHAR(100)  
);  
  
CREATE TABLE Vehicle (  
  V_id INT PRIMARY KEY,  
  make VARCHAR(50),  
  model VARCHAR(50),  
  year INT,  
  location VARCHAR(100),  
  price DOUBLE,  
  status VARCHAR(50)  
);  
  
CREATE TABLE Rent (  
  C_id INT,  
  V_id INT,  
  FOREIGN KEY (C_id) REFERENCES Customer(C_id) ON DELETE CASCADE,  
  FOREIGN KEY (V_id) REFERENCES Vehicle(V_id) ON DELETE SET TNULL,  
  PRIMARY KEY (C_id, V_id)  
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Write SQL queries to answer the following questions.

1. Update table *Customer* by adding a new attribute *Address* of type string of maximum 50 characters.

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2. Find Customers whose names begin and end with *M* and have at least 4 characters.

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3. Delete customers with specific IDs: 510, 104, 768, 290, 875, 1365, 89, 96,777

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4. Update the database by removing vehicles that have never been rented.

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5. Find names of customers who have reserved a car that is not Toyota.

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6. Find names of customers who have not reserved a Toyota car.

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7. Find names of customers who have reserved only Toyota cars.

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8. Find names of customers who have reserved both a Toyota and a Nissan cars.

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9. Find the maker and model of the oldest car.

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10. For each car maker, find details of cars with the highest price.

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Consider the following database relations:

Product(model, maker, type)

Desktop(model, speed, ram, hd, price)

Laptop(model, speed, ram, hd, screen, price)

Printer(model, color, price, type)

Write the required SQL query to answer each of the questions below.

1. Find the manufacturer and speed of laptops with a hard disk of fifty gigabytes. **(1PT)**

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2. Find the printers with the highest price. **(2 PTS)**

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3. Find the laptops whose speed is slower than that of any Desktop. **(2 PTS)**

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4. Find the maker of the color printer with the lowest price. **(2 PTS)**

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5. Find the maker(s) of the desktop(s) with the fastest processor among all those desktop's that have the smallest amount of RAM. **(2 PTS)**

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6. Find for each manufacturer, the average screen size of its laptops. **(2 PTS)**

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7. Find the manufacturers that make at least three different models of Desktops. **(2 PTS)**

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8. Find the average hard disk size of a Desktop for all those manufacturers that make printers. **(2 PTS)**

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